d. 432.

A BRIEFE INTRODUCTION TO GEOGRAPHY;

CONTAINING

A DESCRIPTION OF THE

Grounds, and general part thereof.

Very neceſſary for young Students in that Science.

Written by that Learned Man, Mr. *William Pemble* M. A. of *Magdalen Hall* in *OXFORD.*

OXFORD,

Printed by *Leonard Lichfield* Printer to the Univerſity for *Edward Forreſt* 1685.

To the Reader.

GEntle Reader; *I here preſent unto thy view theſe few ſheets, written by that Learned man* Mr. *WILLIAM* PEMBLE, *I doubt not to call him the father, the child favours him ſo much. It hath long laid hid form thy ſight, but now at length emboldned upon thy courteous acceptance of his former labours, it looks abroad into the World: It is but little, let not that detract any thing from it, there may ly much, though penn'd up in a narrow room; when thou readeſt, then judge of it; Thus much may be ſaid; Though many have writ of this ſubject, yet this inferiour to none; thou maiſt obſerve in it, an admirable mixture of Art and delight, ſo that for younger Students it may be their Introduction, for others a remembrancer, for any not unworthy the peruſal: onely, let it find kind entertainment at thy hands. Farewell.*

A BRIEF INTRODUCTION TO GEOGRAPHY.

CHAP. I.

A general deſcription and diviſion of Geography.

TOPOGRAPHIE is a particular deſcription of ſome ſmall quantity of Land, ſuch as Land-meaſurers ſet out in their plots.

Chorography is a particular deſcription of ſome Country, as of *England, France*, or any ſhire or Province in them: as in the uſual and ordinary Map.

Geographie is an art or ſcience teaching us the general deſcription of the whole earth, of this eſpecially we are now to ſpeak of, and alſo Chorography as a part under it contained; both, excellent parts of knowledg in themſelves, and affording much profit and help in the underſtanding of hiſtory and other things.

The parts of Geogrophy are two.

General, which treateth of the nature, qualities, meaſure, with other general properties of the earth.

Special, wherein the ſeveral Countries and Coaſts of the earth are divided and deſcribed.

Of the general in the firſt place, and more at large then of the other, becauſe it is more difficult and hard to be underſtood, and yet of neceſſary uſe, for the unſtanding of the other. This general tract may be parted into five particular heads,

1. Of

1. Of the properties and affections of the earth.
2. Of the parts of it in general.
3. Of the Circles of it.
4. Of the distinction and division of it, according to some general conditions and qualities of it.
5. Of the measuring of it.

These in their order.

CHAP. II.

Of certain general properties of the earth.

IN Geography when we name the earth we mean not the earth taken severally by it self, without the Seas and Waters. But under one name both are comprised, as they are now mingled one with another and do both together make up one entire and round body. Neither do we dive into the Bowels of the earth, and enter into consideration of the natural qualities, which are in the substance of the earth and water, as coldness, driness, moisture, heaviness, and the like: but we look only upon the outside, contemplating the greatness, scituation, distances, measuring, and other such affections which appear in the superficies of it, to the eys of our bodies and minds: These then of the earth and water together, rules are to be kno vn.

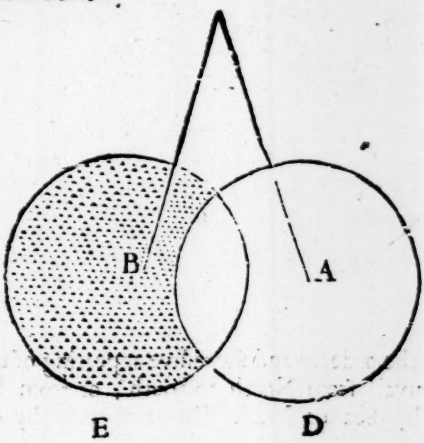
1. *The earth and water do make one Globe, i. e. one round or spherical body.*

The natural place of the water is to be above the earth, and so it was in the first creation of it, compassing the earth round about, as appears, *Gen.* 1. 19. But for the use of man and all other living creatures, God made a separation of them, causing the water to sink down into huge hollow channels, prepared to receive it, that so the dry land might appear above it. Notwithstanding which separation, they do both still remain together, not covering one another as at first, but intermingled one with another, and that so exactly as they now make but one round

round body, whereas at first they made two. Here therefore are two points to be proved, 1. That they are one Globe. 2. That this one is round.

1. They are one Globe, having the same Center or middle point, and the same surface or convexe superficies, which will appear by these reasons.

1. Common Experience. Take a lump of Earth and any quantity of water, and let them both fall down together upon the Earth from some high place, we see that in the descent they do not sever, but keep still together in one straight line, which could not be, if the Earth and Water were two several round bodies, having several centers. As for example, suppose them to be two Globes, and let (*a*) be the center of the Earth, and (*b*) the center of the Water; from (*c*) some high place above the Earth, hurle down Earth and Water, I say the Earth will part from the Water in going down, and the Earth will fall down upon (*d*) and the Water upon (*e*) but this is contrary to Experience, and *ergo* the supposition is false.

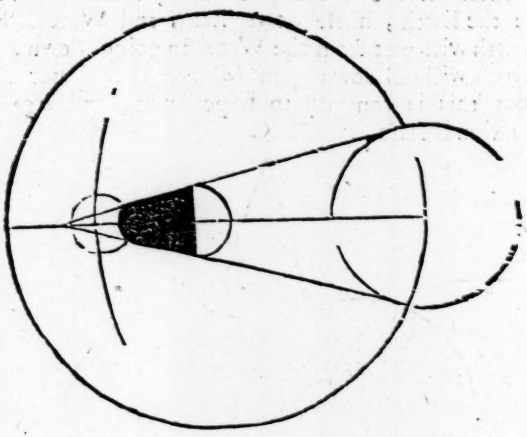


2. The

2. The ſhadow which in Eclipſes is caſt upon the Moon by the Earth and the Water, is but one and not two, and therefore the body is ſo likewiſe. This will appear in the proof of the next point, v. 2.

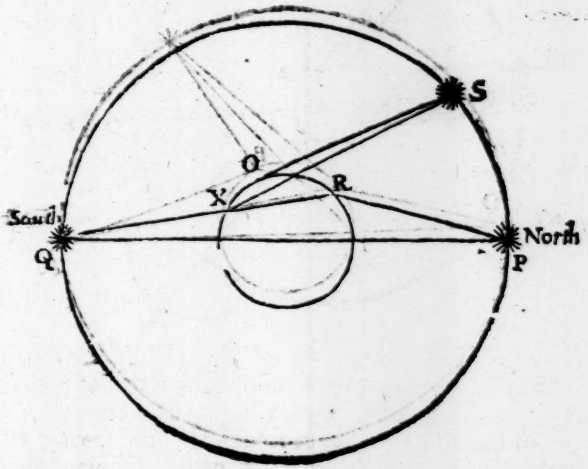
2. *That both Earth and Water are one round body, not ſquare, long, hollow, or any other figure. This is proved by divers reaſons.*

1. By Eclipſes; when the Earth ſtands juſt between the Sun and the Moon, then doth the ſhadow of the Earth falling upon the Moon darken it wholly or in part. Now as is the faſhion of the ſhadow, ſuch is the figure of the body, whence it falls, but the ſhadow of the Earth and Water caſt upon the Moon is round, and alſo one, therefore they are round and alſo one body.



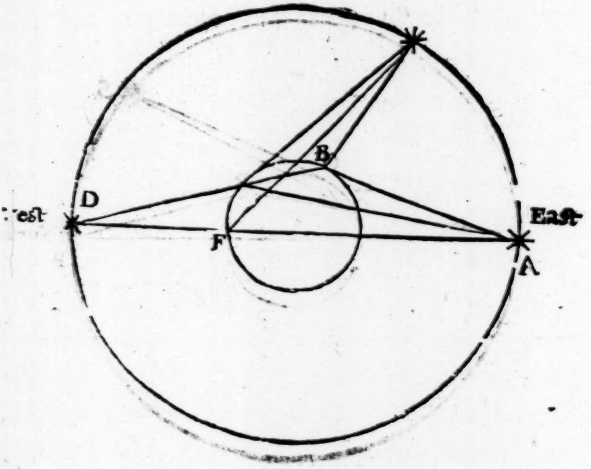
2, By the orderly and ſucceſſive appearing of the ſtars, as men travail from North to South, or from South to North, by Sea or Land. For as they go by degrees, they

they discover new Stars, which they saw not before; and lose the sight of them they did: which could not be, if the Earth were not round. As for example, let (*XOR*) the inward Circle be the Earth, (*QSP*) the outward, the Heaven: they which dwell upon the Earth in (*X*) cannot see the Star (*S*): but if they go Northward unto (*O*) they may see it. If they go farther to (*R*) they may see the Star (*P*); but then they lose the sight of the Star (*Q*) which, being at (*X*) and (*O*), they might have seen. Because, as it appears in the figure, the earth riseth up round between (*R*) and (*X*.)



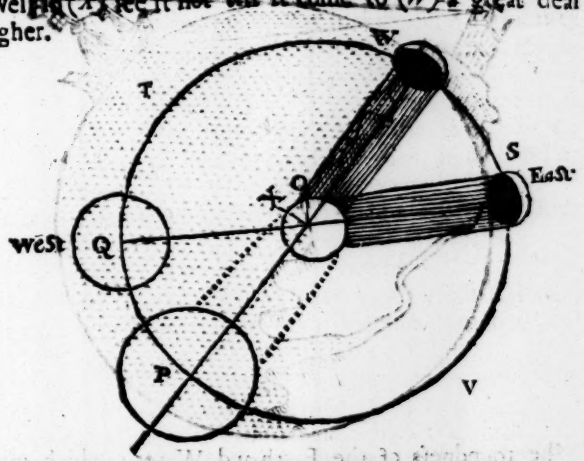
3. By the orderly and successive rising of the Sun and Stars, and setting of the same. Which appear not at the same time to all countries; but unto one after another,

As for example, let (FCB) be the Circle of the Earth, (DEA) the Circle of the heaven from East to West; let (A) be the Sun or a Star. When the Sun (A) is up, and shines upon them that dwell in (B); he is not risen to them that dwell in (C.) Again when he is risen higher and is come to (E) and so shines to them that dwell in (C); he is not yet up to them that dwell in (F.) Again when he sets in the West in (D) and so is out of sight to the inhabitants in (E); he is yet up to them that dwell in (C) and (F) Which shews plainly the Earth is round.



4, By the different observations of Eclipses, One and the same Eclipse appearing sooner to the Easterly Nations than those that lye farther West; which is caused by the bulk of the Earth swelling up between. As for example.

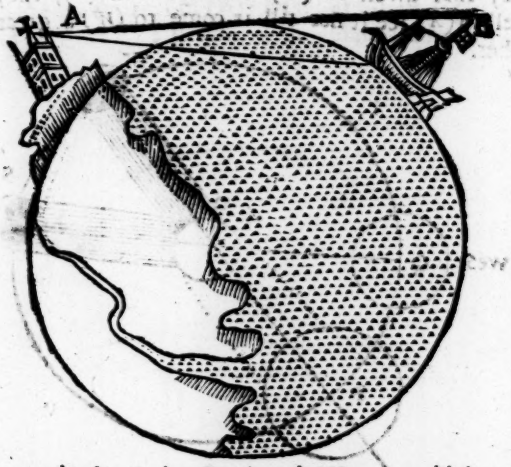
Let (*WO*) be the Circle of the Earth, and (*TV*) the Circle of the Heaven from East to West. Let (*PQ*) be the body of the Sun, (*WS*) of the Moon in the Eclipse by reason of the Earth between it and the Sun. It is manifest that the inhabitants in (*O*) shall see the Eclipse before the inhabitants in (*W*) by certain hours, according as the distance between (*W*) and (*O*) is more or less. They that dwell in (*O*) shall see it in (*S*); they that dwell in (*W*) see it not till it come to (*W*) a great deal higher.



5. That the Water is round (besides from its natural moisture and weight the former rendring it apt to yield and run abroad; and the latter not suffering it to lye in some places higher and some lower, as in hills and dales; but reducing it, when made rough and uneven by tempest, to its natural smoothness and evenness:) I say besides this: it is clear by common experience; for if we stand on land and see a ship go forth to sea, by degrees we lose the sight of it, first of the bulke, then of the Mast. So also on the other side, those that are at Sea by degrees do lose or gain the sight of the Land: As for example.

Let (*A*) be some steeple on the Land, (*B*) a ship at Sea: He that stands at (*A*) shall by little and little lose the sight of the ship as she goes out; and get sight of her as she comes in. Both first and last he shall have the sight of the top mast (*B*) when he sees nothing else; Because the Sea riseth up between his sight and the ship.

These reasons and experiments may suffice to prove



the roundness of the Earth and Water; which might be farther demonstrated by shewing the falsehood of all other figures regular or irregular that can be given unto it: that it is neither square, nor three corner'd, nor Pyramidal, nor Conical or Taperwise, nor Cylindrical like a barly rowl, nor hollow like a dish, nor of any other fashion as some have imagined it to be, We come to the second rule,

2. *The tops of the highest Hills, and bottoms of the lowest Vallies, although in several places they make the Earth uneven, yet being compared to the vast greatness of the whole, do not at all hinder the roundness of it.*

Among

Among all Geometrical figures the ſpherical or the round is the moſt perfect, and amongſt all natural bodies the heaven is the moſt excellent. It was therefore good reaſon the moſt beautiful body ſhould have the moſt perfect and exquiſite ſhape. Exact roundneſs then is not found in any body, but the Heavens; the Earth is round, as was ſhewed; but not preciſely, without all roughneſs and inequality of its ſurface. There are hills like warts, and vallies like wrinkles in a mans body; and that both for ornament and uſe. Yet is there ſuch uniformity in this variety, as that there is no notable and ſenſible inequality made in the earth by hills and vallies. No more then if you ſhould lay a fly upon a ſmooth Cart-wheel, or a Pins head upon a great Globe. Now that this is ſo, appears by ſenſe, and reaſon. By *ſenſe* thus, If we ſtand on a hill or in a plain, when we may deſcry the country round about 15 or 20 miles; we may behold the brim or edge of the Earth round about us to be in a manner even and ſtreight, even there where the country is very hilly, and full of Mountains. So that a-far off their height makes but little alteration and difference from the plain countries, when we behold altogether a-far-off: though when we come near, the alteration ſeems more ſenſible.

By *reaſon* thus, The thickneſs of half the Earth is (as ſhall be ſhewed) about 4000 miles; now the plumb-height of the higheſt Mountains, is not accounted above a mile and a half, or two miles at the moſt. Now between two miles and four thouſand there is no ſenſible proportion: and a line that is four thouſand and two miles long, will not ſeem ſenſibly longer then that which is four thouſand; as for example. Let (*O*) be the center of the earth, (*XW*) a part of the earth which runneth by the bottoms of the hills, and ſuperficies of champaigne and even plains, (*WO*) or (*XO*) the ſemidiameter or half-the depth of the earth, (*S*) a hill riſing up above the plain of the earth

earth, (*WS*) the plumb height of the hill. I say that (*WS*) doth not sensibly alter the length of the line (*Ow*:) for (*WS*) is but two, (*WO*) 4000 miles, and two to 4000 alters not much more than the breadth of a pin to the length of a pearch. So a line drawn from (*O*) the center to (*S*) the top of the hill, is in a manner all one with a line drawn to (*W*) the bottome of the hill.

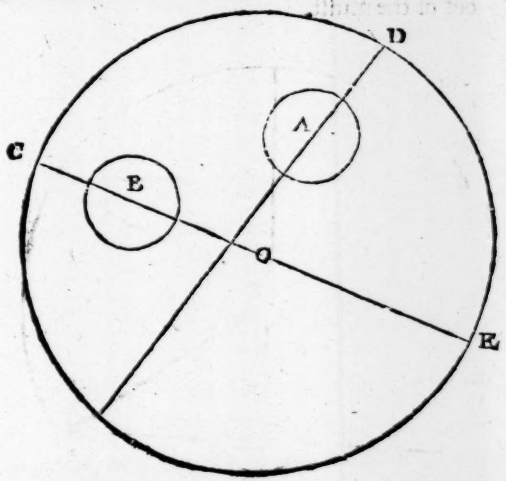
The third Rule.

3. *The earth resteth immoveable in the very midst of the whole world.*

Two points are here to be demonstrated, *First that the earth standeth exactly in the midst of the world. Secondly that it is immoveable.* The former is proved by these reasons.

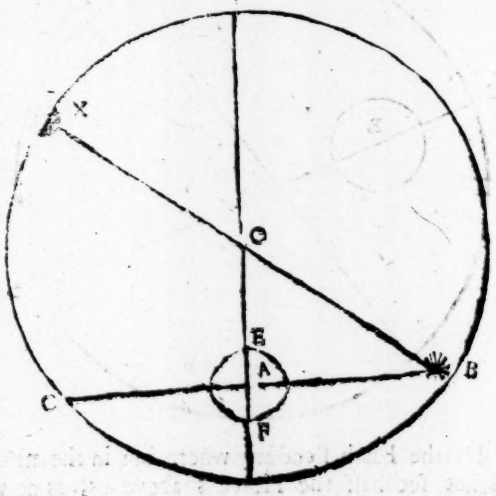
1. The natural heavinesse of the earth and water is such, as they will never cease moving downwards till they come to the lowest place: now the center or middle point of the World is the lowest place, and *ergo* they must needs move thither. as for example.

Let (*O*) be the center of the world, (*CDE*) the heavens: it is manifest that the lowest place from the heavens on all sides is (*O*). Suppose the earth to be in (*A*) or in (*B*) some where out of the center, I say it is not possible (unless it be violently held up) that it should abide there, but it will descend till it come to (*O*) the middle point.



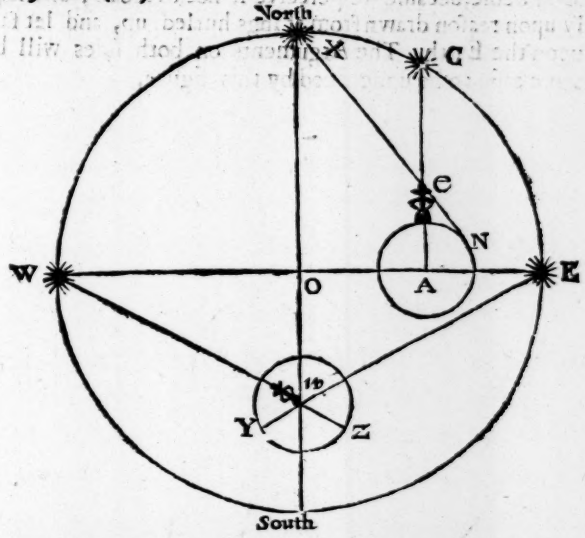
2. If the Earth stood any where but in the midst we should not see half the Heavens above us, as now we do,

do, neither could there be any Æquinox; neither would the days and nights lengthen and ſhorten in that due order and proportion in all places of the World as now they do; again Eclipſes would never fall out but in one part of the Heavens, yea the Sun and Moon might be directly oppoſite one to another and yet no Eclipſe follow, all which are abſurd. As for Example, let the center of the World be (O) let the Earth ſtand in (A) a good way diſtant from the center: it is manifeſt that the greater part of the Heavens (CIB) will allways be above, and the leſſer half (CDB) below; which is contrary to experience. Thence alſo it follows that the days and nights will never be equal, for the Sun (B) will be allways longer above the Earth whilſt he moves from (B) to (C) then below, moving from (C) to (B.) Again the Sun (B) may ſtand juſt oppoſite to the Moon (X) and yet no Eclipſe follow, the Earth which makes the Eclipſe ſtanding out of the midſt.



3. The

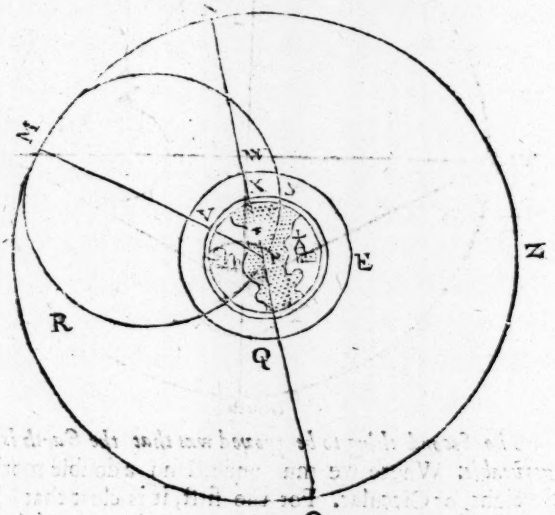
The ſhadows of all bodies on the earth would not fall into that orderly uniformity as they do, for if the earth ſtood towards the East, the ſhadows would be ſhorteſt before noon; if towards the weſt, after noon; if towards the North. the ſhadows would ſtill fall Northward; if towards the South, Southwards: all which experience ſhews to be falſe. As for example, let the earth ſtand Eaſtwards in (A,) the ſhadow of any body upon the earth, as of the body under (e) will be ſhorter in the morning when the Sun is in (C) then at noon when the Sun is in (X:) if the Earth ſtand Southward in (W) the ſhadow of any body will allways fall South, as it doth in the figure (Y) and (Z.)



The Second thing to be proved was that the Earth is immoveable. Where we muſt underſtand a double motion, Streight, or Circular. For the firſt, it is clear that without ſupernatural violence it cannot be moved in any

ſtreight motion, that is, upwards, downwards or towards any ſide it cannot be ſhoved out of its place.

For the Second, whether abiding ſtill in its place it may not move round, the queſtion is diſputed, and maintained on both ſides. Some affirm it may and doth: who think there is greater probability the Earth ſhould move round once a day, then that the Heavens ſhould, by reaſon of the incredible ſwiftneſs of the Heavens motion, ſcarce compatible to any natural body; and the more likely ſlowneſs of the Earths moving. Others deny it, grounding their opinion upon Scripture, which affirms the Earth to ſtand faſt ſo that it cannot be moved; and upon Senſe, becauſe we perceive it not to move; and laſtly upon reaſon drawn from things hurled up, and let fall upon the Earth. The Arguments on both ſides will be more eaſie to be underſtood by this figure.



In this figure it is manifeſt that the Earth in the mid-

deſt

deſt cannot move by any ſtreight motion, upward toward (N;) or ſideward toward (M;) or any other way out of its proper place: and therefore that opinion of *Copernicus* and others, that the earth ſhould move round once a year in ſuch a circle as (MPR,) is moſt improbable and unreaſonable, and rejected by the moſt.

But altho it cannot move ſtreight, it may move round. For tho it be a marvelous great body of unconceivable weight, yet being equally poiſed on every ſide, there is nothing can hinder its circular motion: as in a Globe of Lead, or any other heavy ſubſtance, tho it were Forty Fadome in compaſs, yet being ſet upon its Two Poles it would eaſily be turned round, even with the touch of ones little finger. And therefore it is concluded, that this circular motion is not impoſſible. The probability of it is thus made plain. The whole circuit of the Heavens, wherein are the fixed Stars, is reckoned by Aſtronomers to be 101752500, (*i. e.*) a Thouſand and Seventeen Milliens, five Hundred ſixty two Thouſand, and five Hundred miles. Let this be the compaſs of the circle (NMOZ.) So many miles do the Heavens move in one day, till the ſame point come to the place from whence it went, as till (N) move round and come to (N) again. This being the motion of the whole day 24. hours, how many miles will (N) move in one hour? it will move 4239843 and a half, *i. e.* Forty two Millions three Hundred ninety eight Thouſand four Hundred Thirty ſeven miles and a half. So many miles will (N) move in one hour from (N) to (M.) A motion ſo ſwift that it is utterly incredible. Far more likely it is, the circuit of the Earth (ASXV) being about 24000, *i. e.* Twenty four Thouſand miles more or leſs: it ſhould move round once a day. For then one point as (X) ſhould move in one hour from (X) to (V) but a Thouſand miles: which motion altho it be ſwifter than any arrow or bullet from the canons mouth; yet it is incomparably ſlower than that of the Heavens, where ſo many Millions are poſted over in an hour.

Now for the ſolving of the Celeſtial Phænomena, or appearances, the truth is the ſame, if we ſuppoſe the earth to move; as if we believe it to ſtand ſtill. The riſing of the Sun and ſtars, the motions of all the Planets, will keep correſpondence as now. Nor we fear Jogging; or that Steeples and Towers would totter down: for the motion is regular, and ſteady without rubs and knocks. As if you turn a globe round; it will go ſteadily, and a fly will ſit faſt upon it, though you move it apace. Beſides, the whole body of the aire is carried about with the whirling of the Earth: ſo that the Earth will make no wind, as it turns ſwiftly about; as a wheel will, if it be turned apace.

Notwithſtanding all this, moſt are of another opinion, that the Earth ſtandeth ſtill without all motion; reſt rather befitting ſo heavy and dull a body, then motion. The main reaſon brought to eſtabliſh it is this. Let a Stone be thrown down out of the aire from (W:) if the earth ſtand ſtill, it is manifeſt it will fall upon (X) juſt under it; as we ſee it doth. By common experience a ſtone will fall down from any height upon the place we aimed at: but let the Earth move, the ſtone will not light upon (X,) but ſomewhere elſe as upon (S;) for (X) will be moved away and gone to (V.)

So again let two pieces of ordinance that will ſhoot at equal diſtance be diſcharged one juſt towards the East, the other towards the Weſt: if the Earth move (as they ſay it doth) towards the Weſt, the bullet that is diſcharged Eaſtward will fly farther then that Weſtward. For by the contrary motion of the Earth it will gain ground. But experience hath proved this to be falſe, ſhewing that the bullets fly at equal diſtance.

To ſalve this, anſwer is made, that the Earth by its ſwift motion carries with it, and ſteadily, not only all bodies reſting or moving upon it, but alſo the whole Sphere of Air (WEQ) with all things whatſoever that are moved in it naturally or violently, as Clouds, Birds, Stones hurled

hurled up or down, arrows, bullets, and ſuch like things violently ſhot forth: as may appear in the figure.

The Fourth Rule.

4. *The earth, tho it be of exceeding great quantity being conſidered in it ſelf, yet being compared to the heavens, eſpecially in higher ſpheres, is of no notable bigneſs, but may be accounted as a point or prick in the midſt of the World.*

That the earth is no bigger than a point or pins head in compariſon of the higheſt heavens, will eaſily appear unto us, by theſe reaſons.

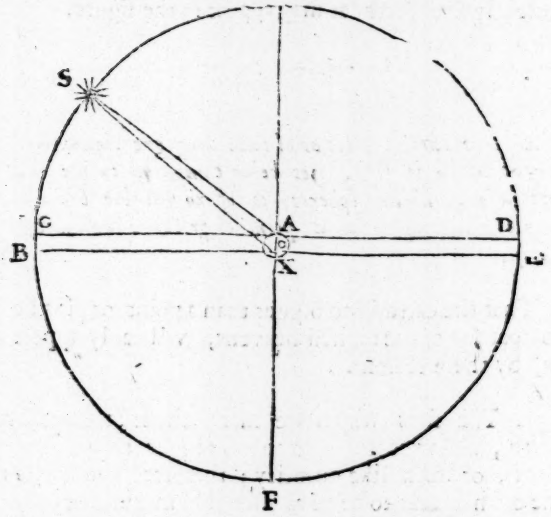
1. The ſtars which are many times bigger then the Earth, ſeem yet to us to be no bigger than a great pins head, or ſuch like quantity; therefore much leſs ſhall the earth appear to be of any ſenſible magnitude.

2. We allways behold half the Heavens above us, which could not be if the Earth had any ſenſible proportion to the Heaven.

3. All obſervations of heights and diſtances of the Celeſtial bodies, which are made on the ſuperficies of the Earth, are as exact, and true, as if they were made in the very center of the Earth. Which were impoſſible, unleſs the thickneſs of the Earth were inſenſible in regard of the Heavens.

4. All Sun Dials which ſtand on the Superficies of the earth, do as truly caſt the ſhadowes of the houres, as if they ſtood in the Center. As for Example.

The



The Star (S) appears like a point or prick to them that dwell in (A:) wherefore the Earth (OX) will appear much leſs to the ſight of him that ſhould behold it from (S ;) nay it would not be ſeen at all. Again, half the Heavens, (BFE) is allways ſeen to them that dwell in (A) wanting ſome two minutes, between (ED) and (BC:) which difference is altogether inſenſible. Again if we obſerve the height of the ſtar (S) above the Horizon (BE:) it will be all one namely (BS) whether we obſerve it in the Top of the Earth, in (A) or in the middle in (O.) For (A) and (O) are ſo little diſtant one from another, that (AS) and (OS) will be parallel lines, and be eſteemed but as one Line. The fourth reaſon concerning Dials, is clear by the frameing and conſtruction of them: wherein either the lower end of the Cock (or Gnomon) whereat all the houre lines meet, or the upper end and knob (as in many dials) is ſuppoſed to be the Center of the Earth.

CHAP.

CHAP. III.

Of the Parts of the Terreſtial Globe.

THe *properties* of the earthly Globe have been handled in the former chapter, we come now to the *parts* which are two in general

{*Earth* / *Water*} Both contain under them more particular parts to be known.

The more notable parts of the *Earth* are theſe.

1. A *Continent* or main Land, or as ſome call it firm-Land, which is not parted by the Sea running between.

2. An *Iſland*, a Land compaſſed about with Waters.

3. A *Peninſula*, a Land allmoſt ſurrounded by waters, ſave at one place, where it joyns by a narrow neck of Land to the Continent; this is alſo called *Cherſoneſus*.

4. An *Iſtmus*, a ſtreight neck of Land which joyns two countries together and keeps the Sea from compaſſing the one.

5. A *Promontorie* or head Land running farr out into the Sea like a wedge.

6. A *Mountaine*
7. A *Valley*
8. A *Champion-plain*
9. A *Wood*

} All eaſie to be known without any definition.

The more notable parts of the *Water* are theſe:

1. *Mare* the Sea, or Ocean, which is the gathering together of all waters.

2. *Fretum* a ſtreight or narrow ſea running between two lands.

3. *Sinus* a Creek, Gulf or Bay, when the Sea runs up into the boſome of the Land by a narrow entrance, but openeth broader when it is within: if it be very little it is called a Haven *Portus*.

4. *Lacus* a Lake, a little Sea within the Land having rivers running into it, or out of it, or both. If it hath neither, it is called *Stagnum* a ſtanding Poole, alſo *Palus*, a fenne

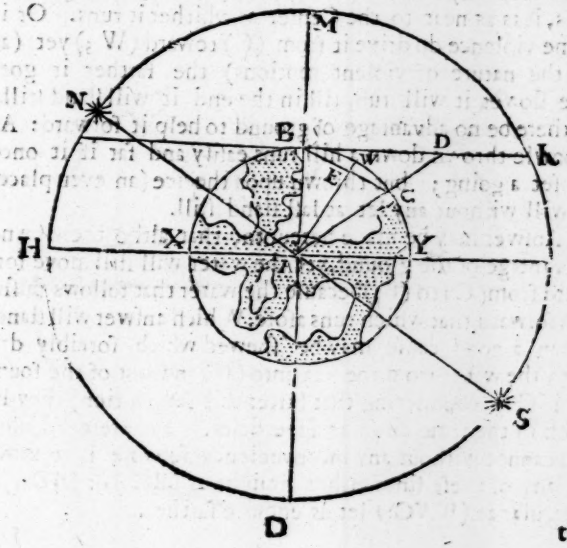
5. *Flu-*

5. *Fluvius* a River, which from the pleasantness is also called *Amnis*: From the smallness *Rivus*.

Now concerning these *parts* divers questions are moved: whether there be more Sea or Land? whether the Sea would naturally overflow the Land, as it did in the first Creation, were it not withheld within its banks by divine power? whether the deepness of the Sea doth exceed the height of the Mountains? whether mountains were before the Flood? what is the height of the highest hills? whether Islands came since the floud? what is the cause of the Ebbing and Flowing of the Sea? what is the original of Springs and Rivers? what manner of motion the running of rivers is? with such like, whereof some belong not so properly to this science of Geography as to others. We speak only a word or two of the last, and so proceed. The question is whether the motion of Rivers be straight or Circular. The doubts on both sides will best appear by a figure first drawn: wherein, let (HMO) be the Meridian of *Alexandria* in *Ægypt*, or of the mouth of *Nilus*, and answerable to the Meridian of the Heavens. Another in the Earth (XBY.) let (B) be the mouth of *Nilus*, and (C) the fountain and head of it. Now the Mouth of *Nilus* where it runs into the Mediteranean Sea, is placed by Geographers in the 31 degree of the North Latitude; and the head of *Nilus* where it riseth is placed by *Ptolomæus* in 11. degree of the South latitude; but by latter and more exact Geographers in the 14 degree of the Southerne latitude: so that the distance between the founts and *Ostia, i.e.* between (C) and (B) is 45 degrees of a great Circle, which after the usual account makes 2700. one eight part of the earths compass. The question now is, whether the running from (C) to (B) continually downward be in a straight line, or circularly in a crooked line. If it run in a straight line, as is most agreeable to the nature of the water, it must move either by the line (CEB;) or by the line (DB.) By the line

(CEB)

(CEB) it cannot move, for when it is come to (E) it will ſtand ſtill: Becauſe from (E) to (B) it muſt move upward, if it move at all; which is contrary to the nature of water. If therefore it move by a ſtraight line, it can be no other but (BD,) and ſo from (D) to (B) it ſhall continually deſcend; for of all places between (D) and (B,) (B) is the neareſt to (A:) But then the fountain muſt not be in (B,) but higher in (D) which ſeems altogether improbable or impoſſible. For firſt the line (AD) would be notable and ſenſibly longer then the line (AB.) For the compaſs of the Earth being about 2400. miles, and the ſemidiameter (AB) or (AC) 3828. miles, the line (GD,) would be 1581. Miles: which cannot be true, if, as we have proved before, the Earth be round, and the higheſt hills make no ſenſible inequality. Again they that dwell in (D) ſhould ſee the North Pole ſtar (N) as well as they that dwell in (B;) which alſo is falſe. So then



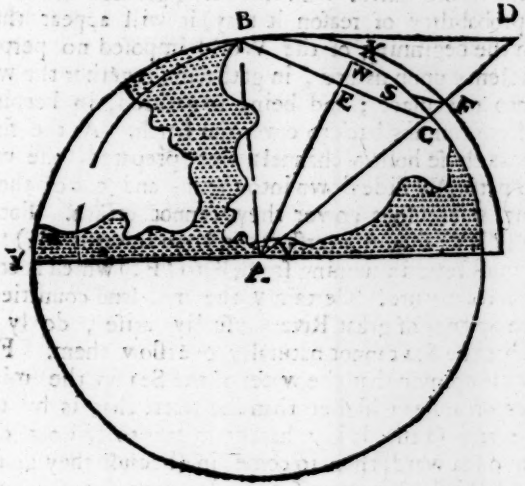
the

the River cannot run either by (EB) or (DB.) Runs it then circularly by the line (GWB?) This ſeems probable; and the rather becauſe hereby a reaſon of the original of Rivers might more eaſily be given. For the fountaine (C) lying even with the Superficies of the Sea the water may eaſily paſs through the hollows of the Earth, and break out at (C) without aſcending. But here alſo are ſome difficulttes: for firſt we find by experience that the fountaines of moſt Rivers, and thoſe great ones too, lie ſenſibly higher than the plain ſurface of the Sea. Again, if the River move directly round, what ſhould be the cauſe that begins and continues this motion? It is a motion beſides the nature of the water, and therefore violent: what ſhould then drive it forward from the Sea to (C) and from (C) to (B?) when the water is at (C) or (W,) it is as near to the Center (A) as when it is at (B:) and therefore it ſhould ſeem with more likelyhood it would ſtand ſtill. for why ſhould it ſtrive to go farther, ſeeing where it is, it is as near to the Center as whither it runs. Or if ſome violence do drive it from (C) toward (W;) yet (as is the nature of violent motions) the farther it goes the ſlower it will run, till in the end it will ſtand ſtill; if there be no advantage of ground to help it forward: As a bowle thrown down a hill runs eaſily and far if it once be ſet a going; but thrown upon the ice (an even place) it will without any let at laſt ſtand ſtill.

Anſwer may be made hereunto, that altho there be no advantage of the ground, yet the water will ſtill move forward from (C) to (B;) becauſe the water that follows puſheth forward that which runs afore. Which anſwer will ſtand. when a good cauſe may be ſhewed which forcibly driveth the water from the Sea unto (C) and out of the fountain (C:) conſidering that (after this ſuppoſition) they lie both in the ſame circular ſuperficies. Wherefore ſeeing we cannot without any inconveniency ſuppoſe it to move by any of theſe lines either ſtraight as (BC) or (BD;) or Circular as (BWC:) let us enquire farther.

The

The moſt likely opinion is, that the motion of the Water is mixt neither directly ſtraight, nor circular: but partly one, partly the other. Or if it be circular, it is in a circle whoſe Center is a little diſtant from the Center of the whole Globe. Let us then place fountains neither in (C,) nor (D,) but in (F.) I ſay the water runs either *partly ſtraight* by the line (FS,) and *partly circular*, from (S) to (B) (which motion will not be inconvenient, for the water deſcending continually from (F) to (S) will cauſe it ſtill to run forward:) or elſe *wholly circular* in the circle (FXB.) And this is moſt agreeable to truth. For ſo it ſhall both *run round*; as it muſt do if we will eſcape the otherwiſe unavoidable inconveniences of the firſt opinion: and alſo in running ſtill *deſcend*, and come nearer to the center, as is moſt befitting the nature of water; ſo that we need not ſeek for any violent cauſe that moves it. Let us then ſee what is the height of (F) the fountains of *Nilus*, above (C) (*i. e.*) (B) the mouth or outlet of it



into the Sea. The uſual allowance in waters courſes is one foot in deſcent for 200 foot in running, but if this be thought too much (becauſe water will run away upon any inequality of ground) for every 500 foot allow one for deſcent: and ſo much we may with reaſon, in regard of the ſwiftneſs of many, yea the moſt Rivers, which in *many* places run headlong, in *all* very ſwiftly (eſpecially *Nilus* whoſe cataracts or downfalls are notable;) which cannot be without ſome notable declivity of the ground. Thus then the whole courſe of *Nilus* being 2700 miles from (F) to (B:) the perpendicular or plumb deſcent of it (CF) will be 5 miles. And ſo high ſhall the Fountain ſtand above the mouth; and the ſurface of the plain land (for Rivers commonly ariſe at foot of hills) which is (BXF) ſwell up above the ſurface of the Sea (BWC) or (BY:) which height of the land above the Sea, altho it be greater than is the height of the higheſt Mountains above the plain land; yet it is nothing in compariſon of the whole Earth. And this being granted (as with more probability of reaſon it may) it will appear that God in the beginning of the World impoſed no perpetual violence upon nature, in gathering together the waters into one place; and being ſo gathred, in keeping them from running back to cover the Earth. At the firſt ſo ſoon as thoſe hollow channels were prepared, the water did naturally ſlide down into them; and out of them without miraculous power they cannot return. For if the Sea (BY) ſhould overflow the Land towards (F:) the water muſt tend in running from (B) to (F;) which is contrary to its nature. Certainly the mid-land countries, whence Springs of great Rivers uſually ariſe, do ly ſo high, that the Sea cannot naturally overflow them. For as for that opinion that the water of the Sea in the middle lies on a head higher than the water that is by the ſhore; and ſo that it is a harder matter to ſail out of a haven to ſea-ward, then to come in (becauſe they go upward:) this is an empty ſpeculation contrary to experience

ence, and the grounds of nature it ſelf, as might eaſily be ſhewed. All the difficulty that is in this opinion, is to give a reaſon how the waters mount up to E; and whence the water comes that ſhould flow out of ſo high a place of the Earth: wherein I think, as in many other ſecrets of nature, we muſt content our ſelves with ignorance; ſeeing ſo many vain conjectures have taken no better ſucceſs.

CHAP. IV.

Of the Circles of the Earth.

IN a round body as the earth is, there can be no diſtinction of parts and places, without the help of ſome lines drawn or imagined to be drawn upon it. Now there are not, nor can be any circles truly drawn upon the earth: yet becauſe there is a good ground in nature and reaſon of things from thence: we muſt imagine them to be drawn upon the earth, as truly as we ſee them deſcribed upon a Globe or in a plain paper. Farther this muſt be noted, that all the Circles on the earth have the like oppoſite unto them conceived to be in the heavens, under which they are directly ſituated. This known, the circles of which that we are to take ſpecial notice are of two ſorts, Greater and leſſer.

The greater circles are thoſe which divide this earthly globe into equal halfes or Hemiſpheares.

The leſſer are thoſe which divide it into two unequal parts, one bigger, another leſſer.

Of the former ſort there are four, the
1. Æquator.
2. Meridian.
3. Horizon.
4. Zodiack, or Ecliptick.

1. *The*

1. *The Æquator or Æquinoctial line, is a line drawn just in the midſt of the earth, from East to Weſt, which compaſſeth it as a girdle doth a mans body, and divideth it into two equal parts, one on the North ſide, the other on the South.* The two points in the earth that are every way farthest diſtant from it North, and South, are called the *Poles* of the Earth, which do directly ſtand under the two like points in the Heaven, ſo called becauſe the Heaven turns about upon them, as the Earth doth in a Globe that is ſet in a frame. This Circle is of the firſt and principal note and uſe in Geography; becauſe all meaſurings for diſtances of places and quarters of the earth are reckoned in it, or from it. It is called the *Æquinoctial*, becauſe when the Sun in the Heavens comes to be directly over that circle in the earth, the days and nights are of equal length in all parts of the world; Mariners call it by a kind of excellency, *The line*. Upon the Globe it is eaſily diſcerned being drawn bigger then any other circles from Eaſt to Weſt, and with ſmall diviſions.

2. *The Meridian, is a line that is drawn quite croſs the Æquinoctial, and paſſeth through the Poles of the Earth, going directly North and South.* It is called the *Meridian*, becauſe when the Sun ſtands juſt over that circle, it is *Meridies*, *i. e.* noon day. It may be conceived thus. At noon-day when it is juſt Twelve a Clock, turn your face towards the South, and then imagine with your ſelf Two Circles drawn, one in the Heavens, paſſing from the North juſt over your head through the body of the Sun down to the South, and ſo round under the Earth up again to the North Pole. Another upon the ſurface of the Earth paſſing through your feet juſt under the Sun, and ſo compaſſing the Earth round till it meet at your feet again, and theſe are Meridians anſwering one to another. Now the Meridian is not one onely, as was the Æquinoctial, but many ſtill varying according to the place wherein you are, as for Example: at *London* there is one Meridian, at *Oxford* another, at *Briſtol* another

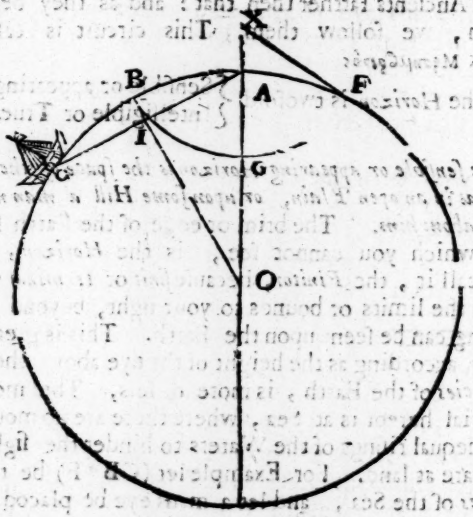
and

and ſo along Eaſtward or Weſtward. For it is noon at *London* ſooner then at *Oxford*, and at *Oxford* ſooner then at *Briſtol*. Upon the Globe there are many drawn, all which paſs through the Poles, and go North and South. But there is one more remarkable then the reſt drawn broad with ſmall diviſions, which runneth through the Canary Iſlands of *Azores* Weſtward of *Spain*, which is counted the firſt Meridian in regard of reckoning and meaſuring of diſtances of places one from another: for otherwiſe there is neither firſt nor laſt in the round earth. But ſome place muſt be appointed where to begin the account: and thoſe Ilands have been thought fitteſt, becauſe no part of the World that lay Weſtward was known to the Ancients farther then that: and as they began to reckon, we follow them. This circuit is called in Greek Μεσημβρινὸς

3. The *Horizon* is twofold { Senſible or appearing. / Intelligible or True.

. *The ſenſible or appearing Horizon is the ſpace of the Earth ſo far as in an open Plain, or upon ſome Hill a man may ſee round about him.* The brim or edge of the Earth farther then which you cannot ſee, is the *Horizon*, or as ſome call it, the *Finitor*, becauſe *finit* or *terminat viſum*, it ſets the limits or bounds to your ſight, beyond which nothing can be ſeen upon the Earth. This is greater or Leſſer, according as the height of the eye above the plain *ſuperficies* of the Earth, is more or leſs, The moſt exact Trial hereof is at Sea, where there are no mountains nor unequal riſings of the Waters to hinder the ſight, as there are at land. For Example let (CBAF) be the *ſuperficies* of the Sea, and let a mans eye be placed in (X) above the Sea; as the eye ſtands higher or lower, ſo will the diſtance ſeen, be more or leſs. As if the height of (XA) be ſix foot which is ordinary the height of a man, the eye looking from (X) to (B) ſhall ſee two miles and three-quarters: if (X) be 20. foot high (BA) will be five miles,

miles; if 40. foot 7. miles; if 50. foot 8. miles. So that from the maſt of a Ship 50. foot high, a man may ſee round about at Sea 8 miles every way, toward (BG) and (F.) So far may the water it ſelf be ſeen; but any high thing on the Water may be ſeen farther 16. or 20. miles according as the height is: as the ſhip at C may be ſeen from X as far more as it is from A to B. There can be therefore no certain quantity and ſpace ſet down for this ſenſible *Horizon*, which continually varies according to the height of the eye above the plain ground or ſea. This Horizon is not at all painted on the Globe nor can be.



The intelligible or true Horizon is a line which girds the Earth round in the midſt, and divides it into two equal parts or Hemiſpheres, the uppermoſt, upon the top and middle point whereof we dwell, and that which is under us. Oppoſite

ſite to this in the Heaven is another Horizon, which likewiſe cuts the Heaven into two Hemiſpheres, the upper and the lower. Above which circle when any ſtar or the Sun is moved, it then riſeth unto us, and ſetteth unto thoſe that dwell oppoſite unto us, and ſo on the contrary. You may conceive it beſt thus, if ſtanding upon a hill, or ſome open place, where you may perfectly ſee the ſetting of the Sun, you mark when the Sun is half gone out of your ſight, you may perceive the body of the Sun cut in two, as it were by a line going along through it, the half above it yet ſeen, that underneath is gone out of your ſight. This line is but a piece of the Horizon, which if you conceive to be drawn upward about the World from the Weſt to the North, and ſo by Eaſt and South, to Weſt again, you have the whole Horizon deſcribed.

This Circle is not drawn upon the body of the Globe, becauſe it is variable; but ſtands on the out-ſide of it, being a broad circle of wood covered with Paper, on which are ſet the months and days of the year, both in the old and new Calender, and alſo the twelve ſigns, and the points of the Compaſs. All which are eaſily diſcerned by the beholding. The uſe of this Horizon is not ſo much in Geography as in Aſtronomy.

The Zodiack is a circle which compaſſeth the Earth like a belt, croſſing the Æquator ſlopewiſe, not ſtraight as the Meridians do. Oppoſite to it in the Heavens is another circle of the ſame name, wherein are the 12. ſignes, and in which the Sun keeps his own proper courſe all the year long, never declining from it on the one ſide or other. The uſe hereof in Geography is but little, onely to ſhew what people they are over whoſe heads the Sun comes to be once or twice a year; who are all thoſe who dwell within 23. degrees of the Æquator; for ſo much is the declination, or ſloping of the *Zodiack*. This circle is alſo called the Ecliptick line, becauſe when the Sun and Moon ſtand both in this circle oppoſite to each other,

then there happens an Eclipſe of the Sun, or Moon, upon a Globe it is eaſily diſcerned, by the ſloping of it from the Æquator, and the diviſions of it into 12. parts, and every of the e 12 into 30. degrees.

Theſe are the greater circles: the leſſer follow; which are all of one nature, and are called by one general name: ſc. *Parallels, becauſe they are ſo drawn on each ſide of the Æquator, as they are equidiſtant unto it every way.* As is eaſy to be ſeen and may be conceived to be drawn upon the earth: but there are only Two ſorts chiefly to be marked: namely the

{ Tropicks, and the } { Polar circles. }

The Tropicks are two parallel circles diſtant on each ſide of the Æquator 23 degrees ſhewing the farthest bounds of the Suns declination North or South from the Æquator, or the midſt of Heaven. And therefore they are called Tropicks à τρέπω *vertendo*, becauſe when the Sun comes over theſe lines, he either turns away from us, as in Summer, or turns toward us again as in the Winter: There are then two of them, *viz.*

{ 1. *The Tropick of Cancer which lies on the North ſide of the Æquator, to which when the Sun comes, it makes the longeſt day in Summer.*

{ 2. *The Tropicks of Capricorne, lying South-ward of the Æquator, to which when the Sun comes, it makes the ſhorteſt day in Winter.*

The Polar Circles are two Parallels drawn by the Poles of the Zodiack compaſſing about the Poles of the World, being diſtant from them every way 23 degrees.

1. *The Arctick Circle that compaſſeth about the North Pole. It is ſo called becauſe that in the Heavens (whereunto this in the Earth lies oppoſite) runs through the conſtellation of the great Beare. Which in Greek is called* Ἄρκτος.

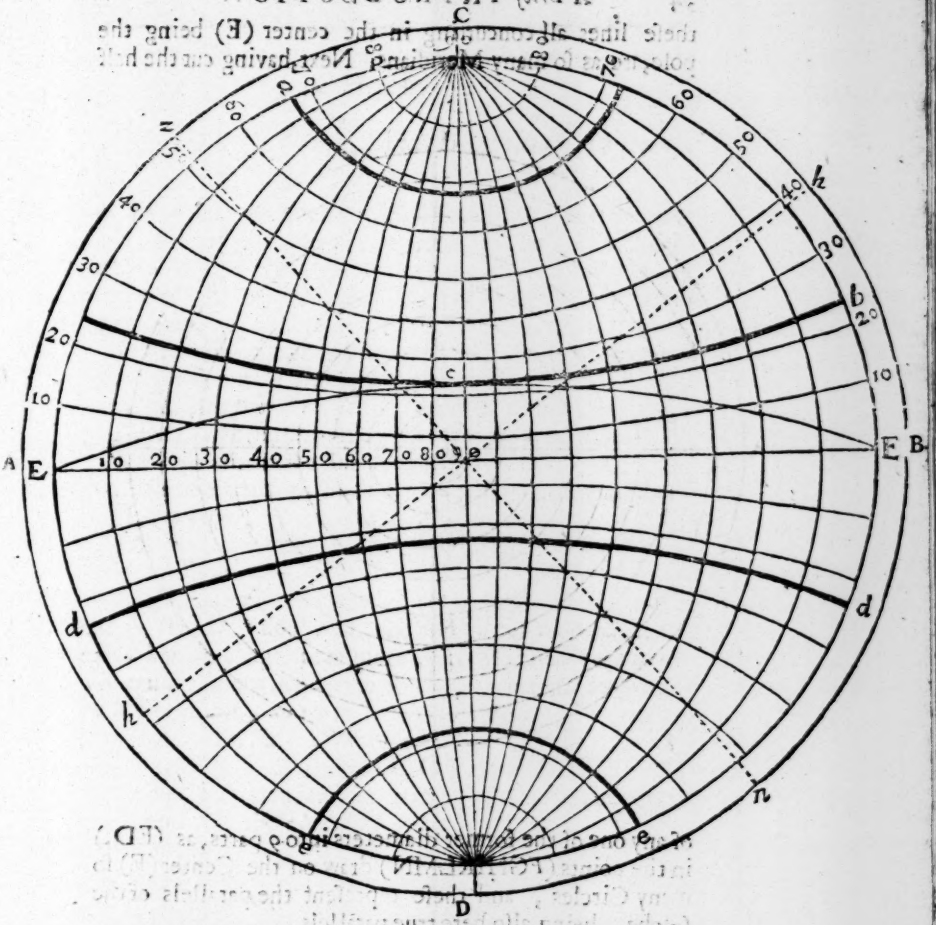
2. *The Antarctick circle that compaſſeth about the South Pole, and is placed oppoſite unto the former.* All theſe with the former are eaſily known upon the Globe by theſe deſcrip-

deſcriptions, and names uſually added unto them. But becauſe Maps are of an eaſier price, and more common uſe then Globes, it will be needful to ſhew how all theſe Circles, which are drawn moſt naturally upon a round Globe, may alſo as truly, and profitably for knowledge and uſe be deſcribed upon a plain paper. Whereby we ſhall underſtand the reaſon of thoſe lines which we ſee in the uſual Maps of the World, both how they are drawn and wherefore they ſerve. Underſtand therefore, that in laying down the Globe upon a plain Paper, you muſt imagine the Globe to be cut in two halves thorow the midſt, and ſo to be preſſed down flat to the paper, as if you ſhould take a hallow diſh, and with your hand ſquieze the bottom down till it ly flat upon a board or any other plain thing: for then will thoſe circles that before were of equal diſtance run cloſer together towards the midſt. After this conceit, univerſal Maps are made of two faſhions, according as the globe may be divided two wayes, either cutting quite through by the Meridian from North to South, as if you ſhould cut an Apple by the eye and the ſtalk, or cutting it through the Æquinoctial, Eaſt, and Weſt, as one would divide an apple through the midſt, between the eye and the ſtalk. The former makes two faces, or hemiſpheres, the Eaſt and the weſt hemiſphere, the latter makes likewiſe two hemiſpheres, the North and the South: Both ſuppoſitions are good, and befitting the nature of the Globe: for as touching ſuch univerſal Maps wherein the World is repreſented not in two round faces but all in one ſquare plot, the ground whereupon ſuch deſcriptions are founded, is leſs natural & agreeable to the globe, for it ſuppoſeth the earth to be like a Cylinder, (or rowl of Bowling-allies;) which imagination unleſs it be well qualified, is utterly falſe, and makes all ſuch Maps faulty in the ſcituation of places. Wherefore omitting this, we will ſhew the deſcription of the two former onely, both which are eaſy to be done.

1. To deſcribe an Æquinoctial Planiſphere, draw a

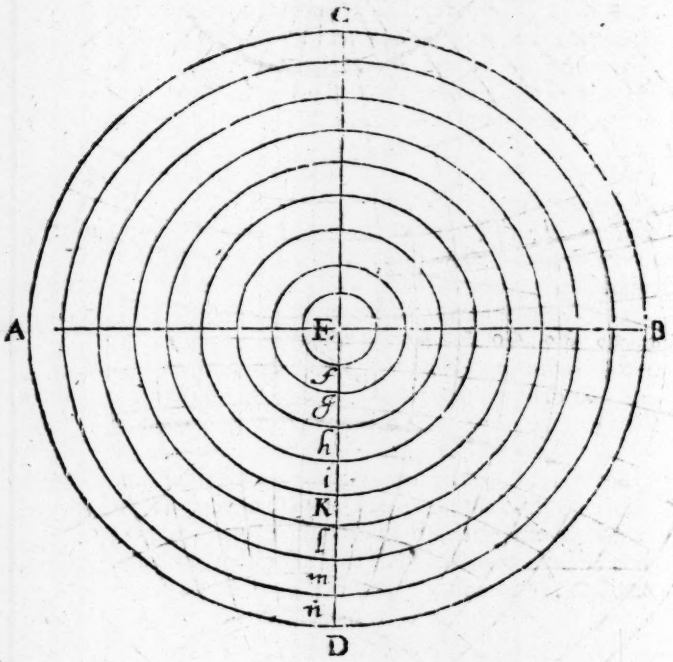
circle as (A B C D) and inſcribe into it two diameters (AB) and (CD) cutting each other at right Angles, and the whole circle into four quadrants: each whereof divided into 90 parts or degrees. The line (AB) doth fitly repreſent half of the Æquator, as the line (CD) (in which the points (C) and (D) are of the two Poles) half of the Meridian; for theſe circles, the eye being in perpendicular line from the point of concurrence, (as in this projection it is ſuppoſed) muſt needs appear ſtreight. To draw the other, which will appear crooked, do thus: Lay a rule from the Pole (C) to every tenth or fifth degree of the half circle (ADE) noting in the Æquator (AB) every interſection of it and the rule. The like do from the point (B) to the ſemicircle (CAD) noting alſo the interſections in the Meridian (CD:) Then the Diameters (CB) and (AB) being drawn out at both ends as far as may ſuffice, finding in the line (DC) the center of the Tenth diviſion from (A) to (G) and from (B) to (C) and of the firſt point of interſection noted in the Meridian from the Æquator towards (C) by a way familiar to Geometricians: connect the three points, and you have the parallel of 10 degrees from the Æquator: the like muſt be done in drawing the other parallels on either ſide of the Æquator; as alſo in drawing the Meridians from centers found in the line (AB) in like manner continued. All which is illuſtrated by the following diagram.

2. To



2. To describe a polar planisphere, draw a circle (ACD B) on the center (*E*) and as before, inscribe in two diameters (AB) and (*BC*) cutting each other at right angles, and the circle into four quadrants. Each quadrants being divided into 90 parts, draw from every 5th or 10th of those parts a diameter to the opposite point

theſe lines all concurring in the center (E) being the pole, are as ſo many Meridians. Next, having cut the half



of any one of the former diameters into 9 parts, as (ED,) in the points (FGHIKLMN) draw on the Center (E) ſo many Circles, and theſe repreſent the parallels of the Globe, being alſo here true parallels.

CHAP. V.

CHAP. V.

Of divers Diſtinctions, and Diviſions of the Earth.

NExt after the Circles of the Earth, we may not unfitly handle the ſeveral diviſions and diſtinctions which Geographers make of the parts, and Inhabitants of the Earth. Theſe are many, but we will briefly run them over.

1. The firſt and moſt plain is by the coaſts of the Heavens, and riſing, and ſetting of the Sun, ſo it is diſtinguiſhed into the

- East: where the Sun ariſeth. *Orient, Ortus ἀνατολή.*
- West: where the Sun goeth down. *Occident.*
- North: between both fromwards the Sun at Noon. *Septentrio.*
- South: between both towards the Sun at Noon. *Meridies.*

Theſe Four are called the chief or Cardinal quarters of the VVorld. They with the others between them are eaſily known, but are of more uſe to Mariners then to us. VVe may rather take notice of thoſe other names which by Aſtronomers, Geographers, Divines, and Poets are given unto them. VVho ſometimes call the East the right hand part of the world, ſometime the VVeſt, ſometime the North, and ſometime the South, the diverſity is noted in theſe Verſes,

Ad Boream terra, Sed Cæli menſor ad Auſtrum.
Preco Dei exortum videt, occaſumque Poëta.

That is Geographers look to the North, Aſtronomers to the South, Prieſts turn them to the East, and Poets to the Weſt.

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This ſerves for underſtanding of Authors, wherein any mention is made of the right or left part of the World. If for Example he be a Poet, he means the South by the right hand, the North by the left; becauſe a Poet turns his face to the Weſt and ſo reckons the quarters of Heaven and Earth.

2. The ſecond diſtinction is by the notable differences of heat and cold, that are obſerved on the Earth, this is the diviſion of the Earth by Zones or Girdles, which the parts of the Earth, wherein heat and cold do remarkably increaſe or decreaſe. Thoſe Zones are 5.

1. The hot or burning Zone (*Zona Torrida*) which contains all that ſpace of Earth, that lieth between the two Tropicks, ſuppoſed heretofore (but falſly as after experience hath ſhewed) to be inhabitable by reaſon of heat, the Sun continually lying over ſome part of it.

2. 3. The temperate Zones wherein neither heat nor cold is extream but moderate: thoſe are two, one on the North ſide of the Æquator, between the Arctick circle, and the Tropick of Cancer, another on the South ſide between the Tropick of Capricorn, and the Antarctick circle.

4. 5. The cold or frozen Zones, wherein cold for the moſt part is greater then the Heat; theſe likewiſe are two, one in the North between the Arctick circle and the North-Pole, another on the South beween the Antarctick circle and the South-Pole. Theſe of all parts of the earth are moſt inhabited, according as extremity of cold is allways a greater enemy to mans body then extremity of heat.

2. The third diſtinction is by the ſhadows, which bodies do caſt upon the Earth, juſt at noon day; for theſe do not allways fall one way but diverſly according to their divers ſcituation upon the Earth. Now in reſpect of the ſhadows of mens bodies, the inhabitants of the earth are divided into the

1. *Amphiſcii* (ἀμφίσκιοι) whoſe ſhadows at noon-day fall

fall both ways, *ſc.* to the North when the Sun is Southward of them, and to the South when the Sun is Northward, and ſuch are thoſe people that dwell in the hot Zone. For the Sun goes over their heads twice a year, once Northward and another time Southward. When the Sun is juſt over their heads they are called *Aſcii*, ἄσκιοι without ſhadow.

2. *Heteroſcii* (ἑτερόσκιοι) whoſe ſhadows do allways fall one way, namely allways towards the North: as thoſe that dwell in the Northern temperate Zone, or allways to the South, as thoſe that dwell in the Southern temperate Zone.

3. *Periſcii* (περίσκιοι) whoſe ſhadows go round about them, as thoſe people who dwell in the two cold Zones, for as the Sun never goes down to them after he is once up, but allways round about, ſo do their ſhadows.

4. The fourth diſtinction is by the ſcituation of the Inhabitants of the earth, compared one with another, who are called either.

1. *Perieci* (περίοικοι) ſuch as dwell round about the earth in one and the ſame parallel, as for Example under the Tropick of Cancer.

2. *Antœci* (ἄντοικοι) ſuch as dwell oppoſite to the former in another parallel of the ſame diſtance from the Æquator. As thoſe under the Tropick of Capricorn.

3. *Antipodes* (ἀντίποδες) who dwell juſt under us their feet oppoſite to ours. 5. The fifth diſtinction is of the length and breadth of the Earth, and places upon it: theſe may be conſidered two wayes.

1. Abſolutely, and ſo the

Longitude or length of the Earth is its circuit, and Extenſion from Eaſt to Weſt.

Latitude or breadth of it, is the whole circuit and compaſs of it from North to South.

2. Comparatively, comparing one places ſcituation with another, and ſo the

Longitude of a place, is the distance of it from the first Meridian going through the Canary Ilands Eastward. Whereby we know how far one place lies East or West from another.

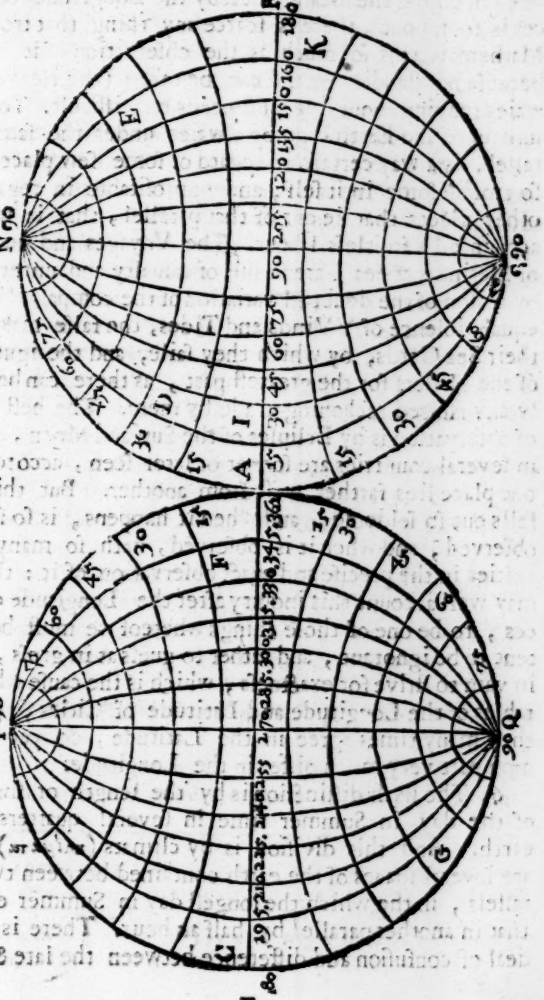
Latitude of a place, is the distance of it from the Æquator towards the North or South: whereby we know how far one place lies Northward, or Southward of another.

The Longitude must be reckoned by the degrees of the Æquator, the Latitude by the degrees of the Meridian.

For Example, in these two Hemispheares, the longitude of the whole Earth is from (C) to (A) and (B) in the Æquator. The Latitude is from (N) to (S) and from (Q) to (P) the North and South Poles, and this reckoned in any Meridian. The first Meridian is (ANBS) which goes by the Canary Ilands, The Æquinoctial is (ABCA) Now I have a City given *&c.* (D.) I would know in what Longitude and Latitude it is. For the Longitude I consider what Meridian passeth through it, which is the Meridian (NDS) which crosseth the Æquinoctial in (I) at 15. degrees, wherefore I say that (D) stands Eastward from the Meridian 15 degrees. So I find that the City (E) is 150 degrees Eastward, (G) 195, and (F) 345.

For the Latitude I consider what Parallel runs through (DEG) or (F) and I find the 30 to pass by (D) 45 by (E) the 15 by (F) the 45 Southward by (G) and those numbers are the Latitude of the place, that are distant from Æquator, (CAB.)

Con-


N 90
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Concerning the means whereby the Longitude of places is found out, there is ſcarce any thing that troubled Mathematicians ſo much as the obſervation of it. For becauſe no ſtanding mark can be taken (the Heavens alwaies running about) it muſt needs be difficult. To meaſure upon the Earth, going alwaies under the ſame parallel, is a way certain in regard of ſome few places, but ſo troubleſome in it ſelf, and unprofitable in regard of other places that lie out of that parallel, that it may be accounted a fruitleſs labour. The Voyages and accounts of Mariners at Sea, are ſo full of caſualty and uncertainty by reaſon of the doubtful variation of the compaſs, the unequal violence of VVinds and Tides, the falſe making of their Sea Cards, by which they ſaile, and the ignorance of the Maſters for the greateſt part, as there can be hardly any aſſured reckoning made by them. The beſt means of obſervation is by Eclipſes of the Sun and Moon, which in ſeveral countries are ſooner or later ſeen, according as one place lies farther weſt from another. But this alſo falls out ſo ſeldome, and when it happens, is ſo ſeldom obſerved, and when it is obſerved, hath ſo many difficulties in the preciſe and exact obſervation of it; that we may well account this inquiry after the Longitude of places, to be one of thoſe things whereof we muſt be content to be ignorant, and rather to gueſs at in groſs, than in vain to ſtrive for exactneſs, which is the cauſe why the tables of the Longitude and Latitude of Cities, though they many times agree in the Latitude, do yet for the moſt part very much differ in the Longitude.

6. The ſixth diſtinction is by the length or ſhortneſs of the day in Summer time in ſeveral quarters of the earth. And this diviſion is by climats (κλίματα) which are ſeveral ſpaces of the earth contained between two parallels, in the which the longeſt day in Summer exceeds that in another parallel by half an hour. There is a great deal of confuſion and difference between the late & ancient

ent Geographers about the diſtinction and diverſe reckonings of the Climats. It is not worth the labour to recount their opinions and Calculations: Thus much is plain, and eaſy to be known: There are 24. Climats, in the day increaſeth by half hours, from 12, houres to 24. There are likewiſe ſix Climats in which the day increaſeth by months, from one month to ſix, that is half a year. Under the Æquator the day is always twelve hours long but as you go from it towards the Pole, the day lengthens ſtill till it come to a day, half a year long. Now in what degrees of Latitude every one of theſe Climats begins and ends, ſhall appear by this Table following.

The uſe of this Table is eaſy. In the firſt Colume are contained the names and number of the Climats. In the ſecond the parallels which encloſe it on each ſide, and and divide it in the midſt. For the parallels here are drawn by every half hours increaſe.

The third Columne is the length of the day in Summer in every Climate, which from 12. hours encreaſeth by half hours to 24. hours, after by months, from one month to ſix.

The fourth contains the degrees of Latitude, how far every Climate, lies from the Æquinoctial.

The fifth contains the ſpace or breadth of every Climate, how many degrees or minutes it takes up upon the Earth.

The ſixth contains ſome notable places by which the Climates paſs.

Hereby it is eaſy to know what the longeſt day is any place of the world whoſe latitude is known, or con-

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Thoſe that dwell under the Pole have not paſt 3 or 4 months profundas tenebras *dark-night, for when the Sun is in* Libra *and* Piſces *being then night, the Horizon it ſends forth to them a Glimmering light not unlike to the dawning of the day in a morning a little before the Sun riſing.* Munſter lib. 1. cap. 5.

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trarily the longeſt day being known to know the latitude. For Example *Oxford* hath latitude 52.0. degrees, longitude 24.0. In the Table I find that 52 degrees of latitude lie in the ninth Climate wherein the day is 16 hours and a half long, ſo much I ſay the day is at *Oxford* in Summer. The place of *Oxford* in the hemiſphear is at V.

Upon Globes the Climates are not uſually deſcribed, but are noted out upon the brazen Meridian. So alſo in univerſal Maps they are ſeldome drawn, to avoid confuſion of many lines together, but they are many times marked out on the limb or edge of the map.

The ſeventh and laſt diſtinction of the earth is taken from the ſcituation of it in reſpect of the Heavens, and eſpecially the Suns motion. In regard whereof ſome parts or inhabitants of the earth, are ſaid to be, or dwell in a right ſphear, ſome in a parallel ſphear, and others in an oblique or crooked ſphear.

They dwell (in *Sphera recta*) in a right or ſtraight ſphear who dwell juſt under the Æquinoctial, whoſe Horizon is parallel to the Meridians, but cuts the Æquator at right Angles.

They dwell in parallel Sphears, who dwell juſt under either of the Poles, whoſe Horizon is parallel to the Æquator, but cuts all the Meridians at right Angles: and the latter is ſometime called a parallel ſphear.

They dwell in (*Sphera Obliqua*) in a crooked ſphear, who inhabit any place berween the Æquinoctial and the Pole whoſe Horizon cuts the Æquator, the parallels, and the Meridians at oblique or unequal Angles.

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CHAP. VI.

Of the measuring of the Earth.

WE are now come to the last point concerning the measuring of the Earth, which is two-fold, either of the { 1. Whole Earth. 2. Several parts thereof, and their distance one from another.

Concerning the first it is but a needless labour to recount, the diversity of opinions that have been held from time to time by learned Geographers, what is the compass and depth of the Earth. This may be seen in *Hues de usu Globi, part. 3. cap. 2.* and in *Clavius* on *Sacrobosco* with others. They all differ so much one from another, that there is no certainty in trusting any of them. The most common and received opinion is, that the circuit of the earth is 31600 miles, reckoning 60 miles for every degree, and then the depth or Diameter of the Earth shall be 6877 English miles, containing 5000 foot in a mile.

The means whereby the circuit and diameter of the earth: are found out are principally two.

1. By measuring North or South, under one Meridian some good quantity of ground, threescore or an hundred miles (or two for the more certainty) for in those petty observations of small distances there can be no certain working. This may be done, though it be laborious, yet exactly without any sensible error by a skilful workman plotting it but upon his paper, with due heed taken that he often rectify the variation of the needle (by which he travels) upon due observations, and that all notable ascents and

and deſcents, with ſuch winding and turning as the neceſſity of the way cauſeth, be reduced to one ſtraight line. By this means we ſhall know how many miles in the earth anſwering to a degree in the Heavens, if exact obſervation by large inſtruments be made to find the elevation of the Pole, in the firſt place where we begin to meaſure, and the laſt where we made an end.

Beſides this way of meaſuring the circumference of the earth, there is none other that hath any certainty of obſervation in it. That by Eclipſes is moſt uncertain, for a little error in a few minutes of time (which the obſervers ſhall not poſſibly avoid) breeds a ſenſible and foul error in the diſtance of the two places of obſervation. That of *Eratoſthenes* by the Sun-beams, and a ſhadow of a ſtile or Gnomon ſet upon the earth, is as bad as the other. For both the uncertainty of the calculation is ſo ſmall quantity as the ſhadow and the Gnomon muſt needs have and the difficulty to obſerve the true length of the ſhadow, as alſo the falſe ſuppoſition whereupon it proceeds taking thoſe lines for parallels which are not, do manifeſtly ſhew the reckoning hereby made to be doubtful and not ſure.

2 The ſecond is by meaſuring the ſemi-diameter of the earth: For as the circumference makes known the diameter, ſo doth this the circumference. This may be done by obſervation made upon ſome great hill, hard by the ſea ſide. The invention is of *Maurolycus Abbot* of *Meſſana* in *Sicilia*, but it hath been perfected, and more eaſily performed by a worthy Mathematician *E. W.* who himſelf made proof of it. By this art was the ſemi-diameter of the earth to be 183126$\frac{21}{100}$ foot: which allowing 5003 foot to a mile is 3662 and a half miles, which doubled is the whole diameter 7325 miles. The circuit of the earth ſhall be 23030 miles, and one degree contains 63$\frac{7}{11}$ miles, which is almoſt 64 miles, which as it exceeds the ordinary account, ſo may we reſt upon it as more exact than any other.

2. The

2. The second point concerning the measuring of particular distances of places one from another is thus performed.

First upon the Globe it is most easy. With a pair of Compasses take the distance between any two places howsoever scituated upon the Globe, and apply the distance so taken to the Æquator, and see how many degrees it takes up; those degrees turned into miles shew the distance of the two Cities one from another. Upon Universal Maps there is a little more difficulty in finding the distance of places, which here must be considered in a three fold difference of scituation:

1. Of Latitude only.
2. Of Longitude only.
3. Of Latitude and Longitude together.

1. If the two places differ only in Latitude, and lie under the same Meridian, if the places lie both on one side of the Æquator the difference of the Latitudes, or the summe of both Latitudes added together, if one place lie North and another South, being turned into miles gives the true distance.

2. If the places differ only in Longitude, and lie both under one parallel of latitude, the difference of Longitude turned into miles proportionably according to the Latitude of the parallel, gives the true distance.

3. The distance of places differing both in Latitude and Longitude may thus be found out, first let there be drawn a semicircle upon a right diameter noted with (ABCD) whereof (D) shall be the center. The greater this semicircle is made, so much the more easy will the operation; because the degrees will be larger.

Then this semicircle being drawn, and accordingly divided, imagine that by the help of it, you desire to find out the distance betwixt *London* and *Jerusalem*, which Cities are known to differ both in Longitude and Latitude. Now that the true distance betwixt these two places may be found out, you must first substract the lesser longitude out of a greater, so shall you find the differences of their Longitudes, which is 47 degrees. Then reckon that difference upon the semicircle, beginning at (A) and so proceed to (B,) and at the end of that difference make a mark with the letter (D) unto which point by your ruler, let a right line be drawn from (D) the center of the semicircle. This being in this sort performed, let the lesser latitude be sought out which is 32 degrees, in the aforesaid semicircle, beginning your account from the point (E) and so proceed towards (B,) and at the end of the lesser latitude let another point be marked out with the letter (G) from which point, let there be drawn a perpendicular line which may fall with right angles upon the former line drawn down from (D) to (F) and where it chanceth to fall, there mark out a point with the letter (H.) This being performed let the greater latitude which is 51 degrees 32 minutes, be sought out in the semicircle beginning to reckon from (A) towards (B) and at the end of that latitude set another point signed out by the letter (I) from whence let there be drawn another perpendicular line that may fall with right Angles upon the Diameter (AC,) and there mark out a point with the letter (K,) this done take with your compass the distance betwixt (K) and (H) which distance you must set down upon the diameter (AC,) placeing the one foot of your Compass upon (K) and the other towards the center (D) and there mark out another point with the letter (L) then with your compass take shorter perpendicular line (GH,) and apply that wideness upon the longer perpendicular line (IK,) placeing the one foot of your compass at (I)

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which is the bounds of the greater Latitude, and extend the other towards (K,) and there make a point at (M) then with your compaſs take the diſtance betwixt (L) and (M) and apply the ſame to the ſemicircle, placeing the one foot of your compaſs in (A) and the other towards (B,) and there mark out a point with the letter (N) now the number of degrees comprehended betwixt (A) and (N) will expreſs the true diſtance of the two places, which will be found to be 39 degrees: which being multiplied by 60 and ſo converted into Miles according to the former rules, which will produce 2340. which is the diſtance of the ſaid places.

FINIS.